

Capital Expenditures in Selected Manufacturing Industries

By Lowell J. Chawner

CAPITAL expenditures in manufacturing industries in the United States since the first World War have exhibited wide differences among the separate industry groups. These differences in capital outlays are conspicuous in the long-time trends and in the fluctuations over periods of several years. They are not appreciable, however, in the timing of the short-run movements, which in many industries exhibit the characteristic fluctuations of general business conditions.

Technological changes, both in the development of new products and in methods of fabrication, appear to be especially significant influences in determining the volume of capital outlays in individual industries. As far as capital expenditures are concerned, the incidence of these changes is not general but is upon particular industries, processes, and enterprises.

The following article contains estimates of the annual capital expenditures for productive facilities in each of six separate groups of manufacturing industries since the first World War, together with some comments upon the major influences which appear to have been responsible for the fluctuations in these expenditures over that period. The industry groups considered here are food and kindred products; textiles and related products; lumber and lumber products; pulp, paper, and allied products; printing, publishing, and allied industries; and stone, clay, and glass products.

A second article scheduled to appear in an early issue of the Survey will present estimates of the capital expenditures in six other groups of manufacturing industries: blast furnace and steel works products, automobiles, airplanes, petroleum products, rubber products, and leather and leather products.

Heretofore, measures of capital expenditures in individual groups of manufacturing industries have been available only for the year 1939. For that year all manufacturing establishments were requested to report their capital expenditures as a part of the regular Census of Manufactures.

Data for a few important industrial groups, such as chemicals, nonferrous metals, finished iron and steel products, and machinery are not presented because suitable primary statistics have not been developed thus far for estimating the capital expenditures in these industries except for the 1939 data reported to the Bureau of the Census.

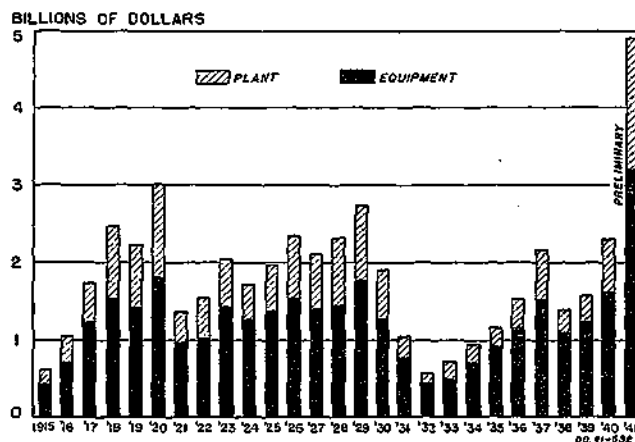
Review of Capital Expenditures, All Industries, 1915-41.

The movement of aggregate capital expenditures for manufacturing facilities from 1915 through 1940 was

discussed in an earlier article.¹ Estimates of these expenditures are shown in figure 11. Since they are in current dollars, they exhibit wider fluctuations than actually occurred in the physical additions to productive facilities.

Few additions were made to manufacturing capital facilities in 1914, the expenditures for this purpose having declined substantially from those of 4 or 5 years earlier. In 1915 the prospects for a long war added greatly to the requirements for war material, particularly explosives, artillery, and shells. Largely initiated

Figure 11.—Estimated Capital Expenditures for Plant and Equipment for All Manufacturing Industries



Source: U. S. Department of Commerce.

by orders from abroad, substantial expenditures (in terms of the prices prevailing at that time) were made for manufacturing facilities in the United States in 1915 and 1916, particularly in the iron and steel industries.

The entrance of the United States into the war in the spring of 1917 made necessary a rapid expansion in plant and equipment for the production of guns, and ammunition, chemicals (powder, synthetic dyes, and basic materials, such as nitrates), and naval and merchant ships. Plants for the fabrication of many of these products were practically nonexistent in the United States and in other cases had fallen into disrepair as a result of inactivity. The tonnage of ships constructed in the year ended in June 1915, for example, was lower than it had been in any year since 1898.

Following the armistice in November 1918, there was a brief decline in the rate of manufacturing capital expansion. However, a number of factors set the stage for a high rate of capital outlays during the immediate

¹ Survey of Current Business, March 1941, "Capital Expenditures for Manufacturing Plant and Equipment," p. 9. References to estimates of expenditures for other producers' goods are given there.

Sources: U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce.

expenditures which cannot be readily interpreted and hence have limited usefulness in the analysis of such expenditures. Also, a single estimate for the textile, apparel, and related industries group has been necessary since available statistics do not make possible the determination of separate estimates for cotton, woolen, and silk textiles, and for apparel.

The estimates for the pulp and paper industry, and the printing and publishing industries are somewhat more satisfactory in this regard. This is likewise true of several of the series to be published in a subsequent article, such as those for automobiles and rubber products. However, in all cases the estimates have been made in the greatest detail possible with available statistical materials.

It is beyond the scope of this article to give an extended historical account of the technological and economic developments affecting each of the industry groups for which estimates of capital expenditures are shown in table 1. However, in the following paragraphs a few comments are made upon the principal changes in demand, new products, methods of fabrication, profitability, and other characteristics of the various industries which are believed to have a special bearing upon the capital expenditures in these industries during the past two decades.

Food and Kindred Products.

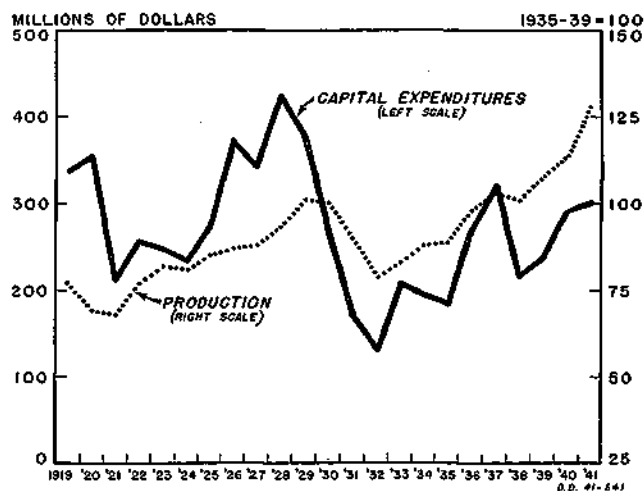
Food processing in a factory rather than on a farm or in the household kitchen has been well established for nearly three-quarters of a century in the United States. Nevertheless, the extent to which foods are thus prepared for final consumption has continued to increase very substantially in recent years.

Census statistics disclose no conspicuous change (actually a very small decline is indicated) in the relative proportion which the physical production in food manufacturing establishments has been of the total production in all manufacturing since the year 1899, but the "value added" in food processing does appear to have increased relative to the total for all manufacturing.³ Also in food processing, mechanization has increased rapidly during the past two decades. At present the portion of the manufacturing effort (measured by the value added) which is attributable to the use of capital facilities in food processing is larger than that in textiles and apparel, leather and leather products, automobiles, and several other industry groups.

The fluctuations in the capital outlays made in the food and kindred products industries (see fig. 12) are attributable in a number of cases to special conditions which can be identified. In 1919 and 1920 the relatively high capital expenditures were due principally to additions to flour mills and other grain mills, and to a somewhat lesser extent to expansion in confectionery and ice-cream plants. The former were greatly influ-

enced by the unusual demand for wheat flour during the first World War and immediate post-war years which resulted from the curtailed grain production in Europe and the special advantages which the United States had over the two other principal sources of supply, Australia and Argentina, because of its closer proximity to Europe in a period when shipping space was at a premium. Many of the capital expenditures in flour milling were also prompted by the desire to attain the greater efficiencies possible in the larger, highly mechanized mills.

Figure 12.—Estimated Capital Expenditures for Plant and Equipment and Index of Production for Food and Kindred Products



Source: Capital Expenditures for all years and Estimated Production for 1941, U. S. Department of Commerce; Production for 1919-40, Board of Governors of the Federal Reserve System.

The expansion in flour-milling facilities in 1919 and 1920 thus occurred partly in response to abnormal conditions. Together with the declining consumption of wheat flour per capita in the United States, this expansion left flour millers with productive capacity in excess of that necessary at any time during the past two decades.

The particularly large capital outlays during the years from 1926 through 1929 reflect changes in the packaging of foods for the retail market and the extensive modernization of food-processing facilities. The expenditures for this purpose of approximately 420 million dollars in 1928 was larger than in any other year during the period covered by these estimates. Many products, such as sugar, cereals, and baker products of various kinds, formerly sold in bulk, were increasingly prepared for marketing in packaged form. New processes, such as the quick freezing of fruits, vegetables, and other fresh foods, were introduced during this period. The canning of fruits and vegetables and the use of refrigeration and air conditioning in food-processing plants also expanded greatly.

Considerable centralization of food processing into larger, more efficient plants and a consolidation of many concerns into large processing and distributing corporations occurred during these years. These changes,

³ See "The Output of Manufacturing Industries, 1899-1937," p. 74; Solomon Fabricant; National Bureau of Economic Research, 1940.

together with some increase in the total demand for food products during the 1920's, are believed to be largely responsible for the very large capital expenditures in the latter part of that decade.

The rise in capital outlays in the food manufacturing industry in 1933 and 1934 is attributable very largely to extensive expenditures upon breweries and distilleries. For purposes of industrial classification, following the Census Bureau practices, brewing and distilling of alcoholic liquors, as well as the processing and bottling of nonalcoholic beverages, are included in the food and kindred products groups of industries.

In 1936 and 1937 the recovery in general business was accompanied by sizable capital expenditures for baking machinery, bottling machinery of various kinds, canning plants (especially for fruit and vegetable juices), and plants for the processing of salad dressings and similar products.

New products, increasing mechanization, plant modernization, and other technical changes in the food industries clearly have been major factors influencing the capital expenditures in this industry during the past two decades. Also, the greatly increased employment of women in gainful pursuits outside of the home, which began during the World War, undoubtedly stimulated the demand for prepared foods and thus for the facilities required in their fabrication. Notwithstanding the major influence upon capital expenditures of changes in products or process or of advances to new high levels of production, it should be observed that outlays for these purposes frequently are delayed until, in the judgement of individual enterprisers, economic conditions warrant the expenditures.

Textiles and Related Products.

Spinning and weaving have experienced approximately two centuries of active technological change. This process, as well as the migration of the textile industries, has continued up to the present time.

During the 1920's several important developments occurred which resulted in substantial capital outlays by textile manufacturers in the United States. The major change of this character in the cotton textile branch was the rapid increase of facilities in the Southeastern States, a movement which had been going on for many years but which was particularly active immediately following the World War. The post-war decade also experienced an active growth in plants for the manufacture of full-fashioned hosiery and, in the latter part of the decade, an expansion of facilities for the processing of rayon fabrics.

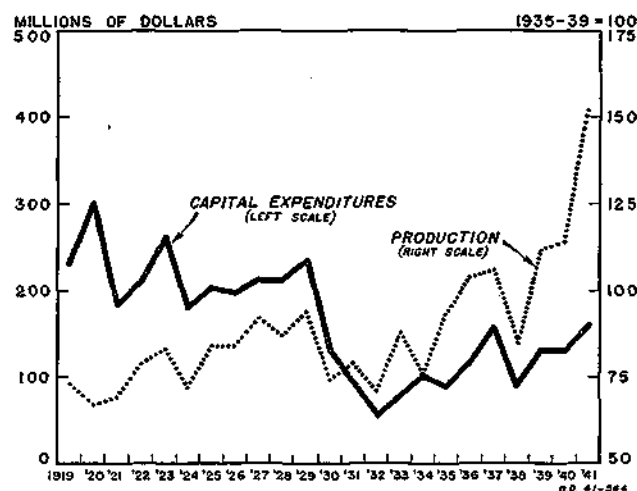
Moreover, throughout the past two decades, improvements have gradually been made in the speed and reliability of operation of spindles and looms in all of the textile industries. For example, the cotton processed per spindle-hour has increased since 1919 by approximately 50 percent for the entire industry in the

United States. As a result of these improvements, together with multiple-shift operation, the cotton actually processed per average active spindle has more than doubled since 1919.⁴

Keen competition in the textile industries has resulted in considerable adoption of this improved machinery during the past 20 years. Expenditures upon new buildings, however, have been very small since 1929 with the sole exception of new structures for the manufacturing of fabrics from synthetic fibers.

Nearly all branches of the textile and apparel industries experienced heavy demand, received high prices, and had excellent profit records in 1919 and early 1920.⁵ These conditions led to very large capital out-

Figure 13.—Estimated Capital Expenditures for Plant and Equipment and Index of Production for Textiles and Related Products



Source: Capital Expenditures for all years and Estimated Production for 1941, U. S. Department of Commerce; Production for 1919-40, Board of Governors of the Federal Reserve System.

lays at that time, particularly in 1920. The capital expenditures of 300 million dollars for the textile and related products industries in that year are the largest on record. (See fig. 13.) Late in 1920, the general price decline was followed by a reduction in capital outlays which extended through the following year.

The recovery in capital expenditures in 1923 was due principally to the expansion of cotton spinning and weaving in the Southeastern States, and to some expansion in the woolen and worsted mills in New England. Some expansion of capital facilities in the cotton spinning and weaving industry in the Southern States continued until about 1930. The New England States, however, have experienced a steady reduction of such facilities since 1923.

Although the physical output of textiles and apparel

⁴ See "Cotton from Raw Material to Finished Product", The Cotton Textile Institute, 1940.

⁵ See Ralph C. Epstein, "Industrial Profits in the United States," National Bureau of Economic Research, 1934; also Leland Rex Robinson, "Corporate Earnings on Share and Borrowed Capital in Percentages of Gross Income (1918-40)," Journal of the American Statistical Association, June 1941, pp. 253-264.

of various types has been well maintained and in the aggregate has a slightly rising trend over the past two decades, total capital expenditures in this industry show a pronounced downward trend over the same period (see fig. 13). In the absence of any major advance in demand or technology, capital expenditures would be expected to remain below the levels attained during the early part of the 1920 decade. Today, however, many textile research specialists believe important developments are in prospect which may have a significant influence upon the textile industries in the readjustment following the present war.

The most striking textile development during the past two decades has not been in spinning, weaving, and converting, or in the cutting trades, but in the development of new fibers; notably rayon and nylon. For purposes of industrial classification, the manufacture of these and other synthetic fibers is usually included with the chemical industries. Consequently, capital expenditures for this purpose are not included in the totals shown in figure 13, but in view of their close relationship to the textile industries a brief discussion of this expansion is given in the following paragraph.

Few industrial processes have experienced a more rapid growth than rayon fiber manufacturing. In 1919, approximately 8 million pounds of rayon filament yarn were produced in the United States. The corresponding figure in 1930 was 127 million pounds. During the intervening years, more than 150 million dollars appears to have been spent upon new plant and equipment for the fabrication of this fiber. This expansion was particularly rapid from 1925 to 1929. In 1940, the total production of rayon of all types had reached 390 million pounds of filament yarn and 80 million pounds of staple fiber (a more recent development).

Thus, in a period of approximately two decades, rayon has grown from a practically unknown material to one of our major textile fibers. It is important to observe, however, that the rapid practical expansion of rayon fabrication was preceded by many years of experimentation in search of a synthetic textile fiber, the earliest patent for the fabrication of a cellulose fiber using methods similar to those now followed having been awarded in France in 1874.

Lumber and Lumber Products.

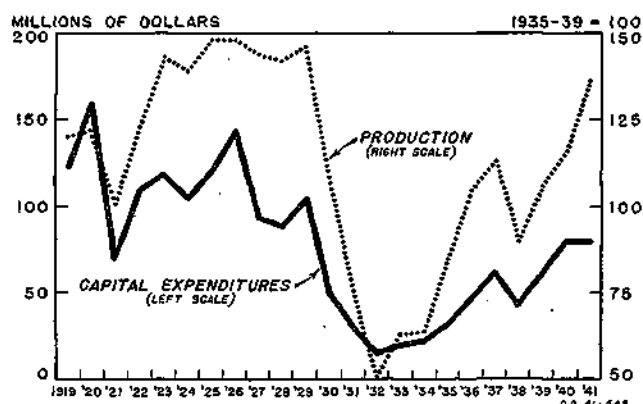
The lumber and lumber products industries are the only major group of manufacturing industries experiencing a declining trend in output since 1899.⁶ Two principal factors tend to account for this: First, increases in the use of competing materials, especially steel, concrete, clay products, and paperboard; second, a declining trend in the activity of some of the processes which use this material.

Considerably fewer residential units appear to have been built during the last decade than during the

decade from 1901 to 1910, which was a period of very substantial construction activity. Railroad construction, which at one time required large quantities of lumber, also has declined over the past 40 years. The relative importance in the uses of lumber of all types in 1939 (based upon the number of board feet) has been estimated as follows: Construction, 68 percent; boxes and crates, 12 percent; railroad structures and rolling stock, 7 percent; furniture, automobiles, and other industrial uses for further fabrication, 9 percent; and exports, 4 percent.

During the past two decades, capital outlays in the lumber and lumber products industries show both a declining trend and wide fluctuations. They were

Figure 14.—Estimated Capital Expenditures for Plant and Equipment and Index of Production for Lumber and Lumber Products



Source: Capital Expenditures for all years and Estimated Production for 1919-22 and 1941, U. S. Department of Commerce; Production for 1923-40, Board of Governors of the Federal Reserve System.

largest in 1920, approximating 160 million dollars, and in 1926 were slightly more than 140 million. The sharp decline following 1926 which was only slightly interrupted in 1929, is conspicuous.

In 1919, lumber production was only slightly more than it had been during the preceding year and less than in any other year since 1908, and it declined still further in 1920. Prices, however, were high and profits unusually large for this industry. This situation appears to be largely responsible for the peak capital expenditures in the lumber and lumber products industry in 1920.

The demand for lumber and lumber products during the years from 1923 to 1929 was substantially above the long-time, declining trend. This was due very largely to the residential building boom and to the substantial volume of other types of construction throughout the entire period from 1923 to 1929. Approximately three-fourths of the lumber production during this period was used in construction, particularly in residential building, which is the principal use for softwood types of lumber.

Capital expenditures in the lumber and lumber products industries were maintained moderately well during the 1920 decade, though they experienced a slight de-

⁶ Fabricant, op. cit.

clining trend. One factor responsible for the moderately large capital outlays in the decade of the twenties was the substantial increase in lumber production in the Rocky Mountain and Pacific States. In all other parts of the country, lumber production appears to have experienced a declining trend.

Considerable centralization and modernization of lumber mills (which account for nearly half of the total value added in the lumber and lumber products industries) occurred from about 1900 to the World War period. Since then, relatively few changes, with the possible exception of kiln drying and the preservative treatment of lumber, have occurred which have influenced substantially the capital outlays in this branch of the industry.

On the other hand, technological advance has been considerable in furniture manufacturing and plywood production, and to some extent in the methods of using lumber in construction—such as prefabrication, timber connectors and the increased use of power saws. Following the practical introduction of moisture-resistant resin glues in the manufacture of plywood in about 1935, the fabrication of this product has increased rapidly and substantial expenditures have been made for productive facilities for its manufacture. The production of Douglas fir plywood, the principal type, increased to nearly three times the 1929 volume in a period of 10 years.

Pulp, Paper, and Allied Products.

The production of pulp and paper products in the United States has increased substantially and with only one important interruption during the past two decades, that of the years 1929–35. Particularly marked increases have occurred in the production of paperboard. Nearly 8 million short tons of paperboard of all types will be fabricated in 1941 compared with less than 2 million tons in 1919.

The production of wrapping papers also has increased from less than 1 million tons in 1919 to 2.3 million tons in 1941. Newsprint paper is the only major product of this industry whose fabrication in this country has decreased since 1919, the largest part (about two-thirds) of our domestic requirements in recent years having been supplied by imports from Canada.

The heavy capital expenditures for pulp and paper making facilities in 1920 occurred in a year of unusually high net earnings for the concerns in this industry and were undoubtedly influenced by that situation. A steady growth which more than doubled the production of all pulp, paper, and allied products from 1921 to 1929 (see fig. 15) resulted in sizable capital outlays in this industry throughout the period, particularly from 1927 through 1929.

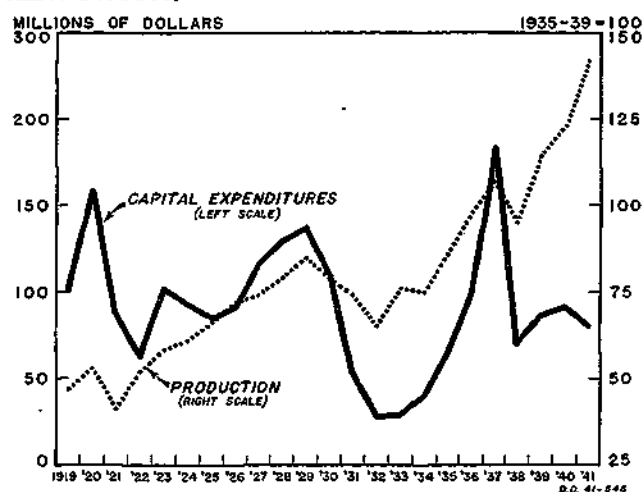
Total output of pulp and paper products was in moderately smaller volume for a few years after 1929, but it had recovered its previous high by 1935 and continued its strong upward trend thereafter. In the following 2 years very large outlays were made in this industry, those of approximately 180 million dollars in 1937 being

larger than in any other year.

This particular expansion in facilities was due predominantly to the practical introduction on a large scale of methods for utilizing Southern yellow pine in the manufacture of sulfate (kraft) pulp and paper products. More recently processes have been developed for the manufacture of a new type of newsprint from this pulp wood, and in 1939 a large Texas mill was constructed for this purpose.

Although the production of all types of paper and allied products has been at record levels for the past 3 years and many plants are now operating close to full capacity, only a moderate expansion in facilities has taken place. In 1939 and 1940 this may have been influenced by a desire on the part of the concerns in this industry to avoid excess capacity at low prices, particularly in view of the prospective revival of large

Figure 15.—Estimated Capital Expenditures for Plant and Equipment and Index of Production for Pulp, Paper, and Allied Products



Source: Capital Expenditures for all years and Estimated Production for 1919–22 and 1941, U. S. Department of Commerce; Production for 1923–40, Board of Governors of the Federal Reserve System.

pulp imports from Scandinavian countries after the war. Today, difficulties in securing machinery and some essential raw materials, prevent any major enlargement of facilities.

Printing, Publishing, and Allied Industries.

The production of newspapers, periodicals, books, and similar printed products increased steadily from 1921 to 1929. This fact tends to account for the sustained capital expenditures in this industry during the 1920 decade.

In the following decade, however, only 2 years, 1937 and 1939, experienced a production in this industry larger than that in 1929, and the production in each of these years was only very slightly larger than that in 1929. Moreover, few technical developments appear to have been made during this period which would tend to stimulate capital outlays for the replacement of existing printing machinery or other equipment. Most types of printing machinery are very carefully made and have a long useful life.

In view of very slight increases in production and the

absence of major technological or other changes, it is not surprising that capital expenditures in printing, publishing, and allied industries have been much smaller in recent years than during the 1920 decade.

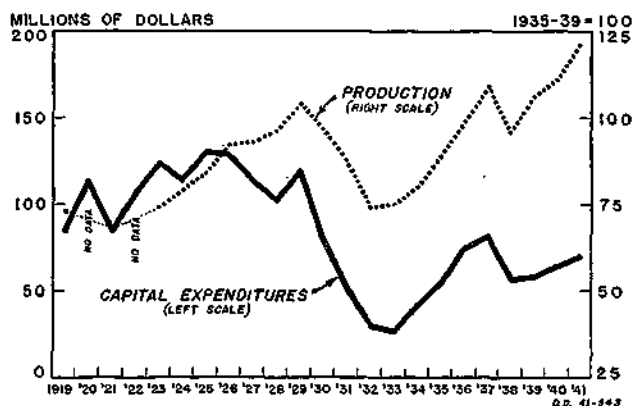
Stone, Clay, and Glass Products.

This group of industries includes establishments engaged in the fabrication of a wide variety of products such as flat glass, glassware, cement, structural clay products, pottery, concrete and gypsum products, cut stone, and miscellaneous nonmetallic mineral products. Many different basic materials also enter into these products.

In view of the diversified character of this group, it is not possible to attach any special significance to the fluctuations in the total capital expenditures for these industries apart from the reflection in the total of the outstanding developments in some of the individual industries.

The steadily maintained capital expenditures in this group of industries from 1919 through 1929, subject only to what appear to be cyclical interruptions in 1921, 1924, and 1927, were to a considerable extent concentrated in cement, concrete products, structural clay products, and flat glass plants (see fig. 17). This expansion reflected the unprecedented volume of building, highway, and other construction during this period, as well as the rapidly increasing demand for plate glass in automobile manufacturing, particularly following the introduction of safety glass. Construction activity

Figure 16.—Estimated Capital Expenditures for Plant and Equipment and Index of Production for Printing, Publishing, and Allied Industries



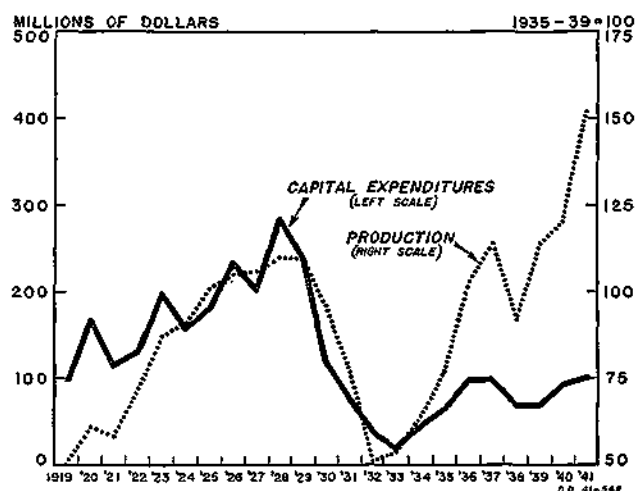
Source: Capital Expenditures for all years and Estimated Production for 1919, 1921, and 1941, U. S. Department of Commerce; Production for 1923-40, Board of Governors of the Federal Reserve System.

declined slightly beginning in 1927 and fell off precipitously after 1930. During the following 4 or 5 years, the volume of construction probably was lower, after making allowances for price changes, than in any year in the United States since 1904.

The capital outlays in the stone, clay, and glass industries in 1928 and 1929 include heavy expenditures by several concerns engaged in flat-glass production, together with sizable capital outlays in the other indus-

tries in this group. During the 1930 decade, the facilities in nearly all stone, clay, and glass industries have been adequate to meet production requirements without further additions to plant and equipment. Also,

Figure 17.—Estimated Capital Expenditures for Plant and Equipment and Index of Production for Stone, Clay, and Glass Products



Source: Capital Expenditures for all years and Estimated Production for 1941, U. S. Department of Commerce; Production for 1919-40, Board of Governors of the Federal Reserve System.

few technological developments have occurred to accelerate the replacement of existing facilities, although improvements in glass container and flat-glass machinery in recent years are important exceptions. However, for the stone, clay, and glass industries as a group, outlays for plant and equipment during the 1930's have been less than half of the average for the preceding decade.

Summary.

An examination of the fluctuations in capital expenditures in the major groups of manufacturing industries leads to 2 observations which warrant special emphasis. First, although the capital outlays in nearly all of the industries reflect to some extent the short-run fluctuations in general business, they exhibit markedly different behavior in their long-run trends and fluctuations. This characteristic will be more evident after an examination of data upon the capital expenditures for all of the 12 manufacturing industries for which such estimates have been made, especially automobiles, blast furnaces and steel works, leather and leather working, and petroleum refining in addition to those treated in this article.

In the second place, capital expenditures in manufacturing industries occur principally as the result of changes—changes in products, technical processes, and advances to new high levels in the demand for existing products, and only to a limited extent as the result of the replacement of plants and equipment arising solely from well-sustained but fundamentally unchanging operations.

Methods of Deriving Estimates

The estimates presented in these articles are derived by indirect methods, with the exception of those for the automobile industry which are based upon reported capital expenditures by several automobile manufacturing corporations that accounted for over 75 percent of the estimated total of such capital expenditures in 1939 and those for the blast furnaces and steel works industry which are based largely upon the capital outlays reported by corporations which accounted for 60 percent of the capital expenditures of this industry in 1939.

With these exceptions the year-to-year changes in each industry have been derived by one or the other of two methods: (a) Gross increments in physical capacity (such as barrels of petroleum throughput) multiplied by appropriate indexes of construction costs, and in one industry (petroleum refining) also by an index representing the effect of technological changes upon construction costs; or (b) a series based upon annual dollar expenditures for factory buildings (derived from reports of contracts awarded) plus estimates of the annual production of industrial machinery (textile machinery, woodworking machinery, printing machinery, food processing machinery, pulp and paper making machines, steam engines, etc.). The latter method follows the procedures used in compiling estimates of total manufacturing capital expenditures described in the March 1941 issue of the Survey of Current Business.

In each industry the bench mark for the estimates throughout the entire period is the capital expenditure for plant and equipment in 1939. These bench marks are based upon the reports made for that year to the Bureau of the Census by every operating manufacturing establishment in the United States. Adjustments to the preliminary Census tabulations were made for some underreporting and for undercoverage due to expenditures involved in the construction of plants during 1939 at establishments which did not operate in that year and consequently did not report to the Bureau of the Census.

Allowances in some industries were made for the production of leased machinery (particularly in shoe manufacturing) and for factory buildings constructed by others than manufacturing concerns for leasing to the latter. In a few industries, especially printing and publishing, allowances were also made for some expenditures for manufacturing facilities by governmental agencies. Although expenditures for manufacturing facilities by the Federal Government are very large in 1941 (considerably more than those by private concerns in this year), such expenditures were quite small in 1939, probably not more than 5 percent of the total. They were also small in other years covered by these detailed estimates with the possible exception of 1919 and 1920 in which years some expenditures were made by the Federal Government upon facilities for shipbuilding purposes in a continuation of the World War program.

The following factors were applied to the capital expenditures for buildings and machinery (excluding land) reported to the Bureau of the Census for 1939, in order to secure the basic estimates referred to above: food and kindred products, 1.20; textiles and related products, 1.25; lumber and lumber products, 1.33; pulp, paper, and allied products, 1.33; printing, publishing, and allied industries, 1.25; stone, clay, and glass products, 1.25.

The estimates of machinery expenditures in the various industries include allowances both for special purpose and some general purpose machinery. The expenditures for some types of general purpose machinery, such as steam engines, steam turbines, and motors can be approximately allocated to the different manufacturing industries on the basis of the increments in the installed horsepower of each of these types of machinery between manufacturing census years. Data of this general character were first reported in 1870. They are available for all but one manufacturing census year from that date to 1920, and were also reported in 1939.

The following brief statements indicate the methods used in deriving the capital expenditures for each of the industries shown in table 1.

Food and Kindred Products.

The year-to-year changes in the capital expenditures in this group of industries were derived by adding estimates of building construction activity (based upon factory building contracts awarded) to estimates of specialized and general purpose machinery. The machinery estimates for biennial census years were derived from the production of special purpose machinery, such as bakers, bottlers, canning, confectionery and ice cream, flour milling, packing house, and refrigerating machinery reported in the Census of Manufactures, together with appropriate allocations to the food industries of general purpose machinery, such as engines, motors, blowers, and packaging machines. Allowances were subsequently made for imports and exports. (See p. 15, March 1941, Survey of Current Business for adjustments used in deriving these estimates.)

The machinery estimates for biennial census years experienced a close covariation with the building construction estimates for these years. Consequently, the machinery estimates for the intercensal years were interpolated graphically by using the relationship between machinery and building construction derived from data for the biennial census years.

Estimates of expenditures for building construction and for machinery in the foods and kindred products industries, secured in the above manner, accounted for approximately 70 percent of the capital expenditures in the base year 1939 derived from direct reports by all concerns in this group of industries to the Bureau of the Census, plus allowances for some underreporting and for undercoverage due to expenditures at new plants which did not operate in that year.

Textiles and Related Products.

Estimates of annual building construction and of machinery expenditures for census years at prices paid by textile manufacturers were secured in the manner previously indicated. The textile machinery estimates included some allowances for attachments, but not for parts, in order to obviate possible double-counting of the latter.

Textile machinery production in the intervening years was calculated by an interpolation based upon textile machinery manufacturing pay rolls compiled by the Bureau of Labor Statistics for 1923 and subsequent years. Machinery estimates for the intercensal years 1920 and 1922 were derived by a relationship established graphically between machinery production and building construction in the biennial census years throughout the entire period. Subsequent allowances were made for imports and exports of textile machinery. Estimates of the total textile building construction and textile and allocable general-purpose machinery secured in this manner, accounted for approximately 80 percent of the capital expenditures reported to the Bureau of the Census for the year 1939 with allowances for undercoverage similar to that indicated for foods and related products.

Lumber and Lumber Products.

Estimates of annual building construction and of machinery expenditures for census years were secured in the manner previously indicated. Machinery expenditures in the intervening years were calculated by an interpolation based upon the shipments of woodworking machinery compiled by the Woodworking Machinery Manufacturers Association. Estimates of the total of building construction and machinery expenditures for the lumber and lumber products industries secured in the above manner accounted for slightly more than 60 percent of the capital expenditures in 1939 based upon the Bureau of the Census returns with allowances for undercoverage.

Pulp, Paper, and Allied Industries.

Estimates of annual building construction and of machinery expenditures for census years were secured in the same manner as set forth above for other industries. The machinery production in intervening years was calculated by an interpolation based upon the gross sales of machinery manufacturing concerns specializing in equipment used in this group of industries.

This method of interpolation was also used in several other industries. For the pulp, paper, and allied machinery, the gross sales of a slightly varying number of corporations, usually 6 to 10 in number, were used. The total building construction and specialized and allocable general purpose machinery for the pulp, paper, and allied products industries derived in the above manner accounted for approximately 65 percent of the capital expenditures reported by establishments in these industries to the Bureau of the Census with allowances for undercoverage.

Printing, Publishing, and Allied Industries.

Estimates of annual building construction and of machinery expenditures for census years were secured in the manner described above. The method used in interpolating expenditures for machinery in the intervening years was calculated by using the gross sales of printing machinery manufacturing concerns.

The total building construction and specialized and allocable general purpose machinery for the printing, publishing, and allied industries derived in this manner was slightly (2 percent) larger than the capital expenditures reported by establishments in this industry to the Bureau of the Census in 1939 after allowances for some undercoverage. This is not surprising in view of the large proportion of specialized machinery used in this industry. It is also possible that the adjustments for mark-up applied to the production value of printing machinery reported by the machinery manufacturing concerns engaged in this business may have been too large. (See p. 15, March 1941, Survey of Current Business.) Also, some of the printing machinery undoubtedly was sold to manufacturers who did a small amount of printing work for their own purposes but did not report this branch of their work as a special census establishment.

Stone, Clay, and Glass.

Estimates of annual construction and of machinery expenditures for census years were secured in the manner previously indicated. The machinery production in the intervening years for this group of industries was calculated by an interpolation based upon the gross sales of machinery manufacturing concerns which specialize in the fabrication of equipment used in these industries. The gross sales of approximately 20 specialized machinery manufacturing concerns were used in interpolating the data for intercensal years in this group of industries.

The total building construction and specialized and allocable general purpose machinery, estimated in this manner for the stone, clay, and glass industries, accounted for approximately 40 percent of the capital expenditures reported by the establishments in these industries to the Bureau of the Census in 1939 with allowances for undercoverage.

Since these estimates in most cases are based upon indirect methods and incomplete reports they should be considered preliminary and subject to revision. The author would greatly appreciate criticisms or suggestions for improving these estimates from persons who have special knowledge of data upon capital expenditures in particular manufacturing industries.